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ABSTRACT

The Lister Hill Experimental Computer Assisted Instruction Network has existed since July 1972. It has connected three university data bases to as many as 80 user institutions. The paper presents a history of the network, compares computer-assisted instruction (CAI) with information storage and retrieval, and summarizes the uses made of the CAI materials offered over the network. (Author)

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THE UTILITY OF COMPUTER ASSISTED INSTRUCTION--AN EXPERIMENTAL NETWORK

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Abstract

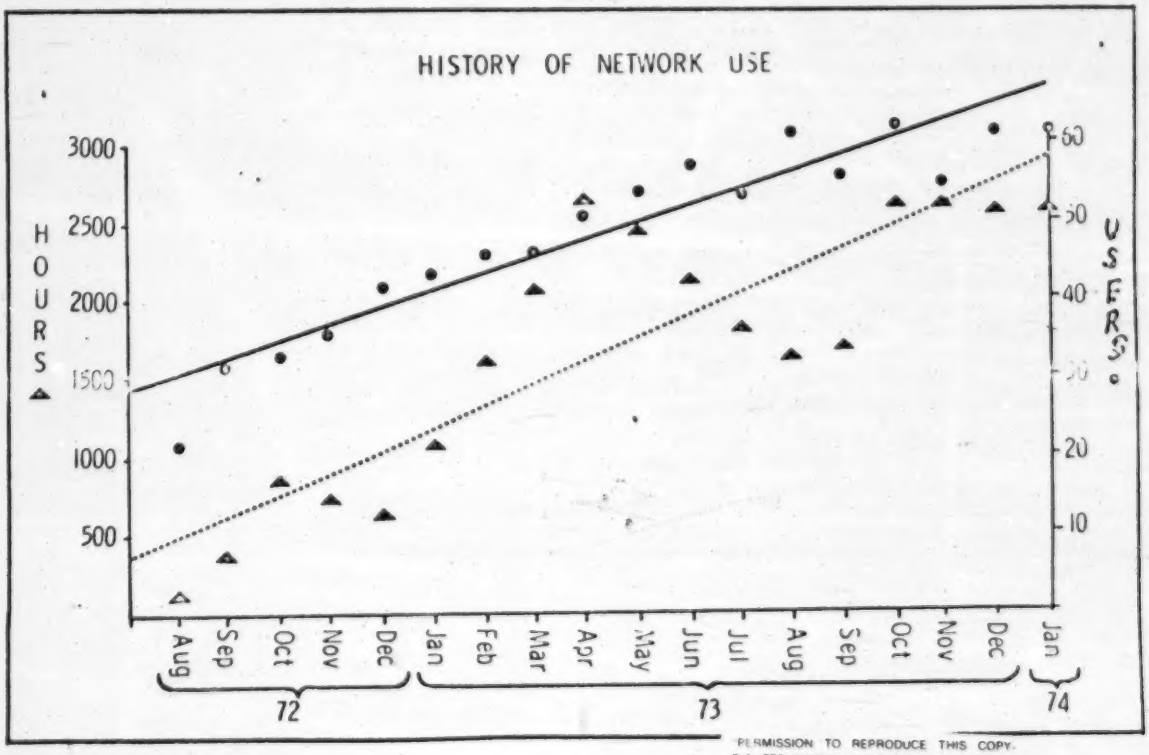
The Lister Hill Experimental Computer Assisted Instruction Network has been in being since July 1972. It has connected three university data bases to as many as 80 using institutions. The paper presents a history of the network, a comparison between computer assisted instruction and information storage and retrieval, and a summary of the uses made of the CAI materials offered over the network.

Background

Since July 1972, the Lister Hill National Center for Biomedical Communications of the National Library of Medicine has managed an experimental time-sharing network for the inter-institutional sharing of biomedical computer assisted instructional materials. The key dates in the present and future history of the network are:

July 1972	Massachusetts General Hospital connected to network
September 1972	Ohio State University College of Medicine connected
January 1973	University of Illinois Medical Center, Chicago, connected
February 1974	Network users charged $2.50/ connect hour
March 1974	University of Illinois withdraws from network
April 1974	Portion of Illinois data base transferred to Ohio State computer
July 1974	Network users charged $5/connect hour
June 1975	Planned termination for present network configuration

The dramatic growth in both number of users and in connect hours is shown in the accompanying graph. The least squares fits used do tend to smooth the rather marked seasonal variations in use, corresponding to the estivation/hibernation cycles of the using institutions.



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From the beginning of the network, using institutions have been required to provide their own terminals, pay communications costs to the nearest node in the network (a local phone call for those in a node city, but $10 an hour if the user is in Utah and the nearest node in California) and assign the necessary faculty to use the CAI materials well and wisely, make periodic reports to us and, D.V., prepare additional units of instruction. Faculty costs can be extensive but have the advantage, from both the using institution's and our point of view, that they can be buried in the institutional overheads. Terminal, communications, and connect-hour costs, on the other hand, are new costs and our using institutions have had to adopt various ingenious expedients for meeting, and occasionally hiding, them.

We are impressed, and fascinated by, those who claim CAI costs of less than $1 per terminal hour. We know our costs, and they are somewhat higher. At the peak of the network, when all three computers were on line, they amounted to almost $19/hour. The major portion of this, $14.27 per hour, was a fixed cost for maintaining the data bases in the host computers, providing small interface computers between each host computer and the network, and providing for a great deal of interaction between the three university computer centers and their relatively naive users. All of these costs are independent of usage, up to port saturation; 2,000 hours a month was used to arrive at the $14.27 figure. Doubling this usage would halve the costs and come uncomfortably close to saturating the ports. (A port corresponds to a telephone number to the computer. A saturated port gives busy signals.)

Communications costs, based on the cost of logging in to the system and the number of characters transmitted, are independent of distance. They are the same between two hospitals in Boston as they are for a call from the University of Washington in Seattle to Columbus, Ohio. These costs are about $4.50 per hour, regardless of the number of hours used. It is these communication costs which we are asking our users to share, and after July 1, 1974, assume.

The consolidation of data bases from three to two computers, which took place in April 1974, has resulted in some savings, dropping the total costs to slightly under $14 per hour. The cost per student interaction, based on two or three students clustered around a terminal and an average of 2.5 lesson sessions per hour, giving an average six student interactions per hour, is about $2.30 per student per lesson.

The true costs of the network are even higher, since the above figures make no provisions for amortizing the costs of developing the data bases. These were created under Federal and, in one instance, state funding at a cost of perhaps $5 million. Our network has made possible the sharing of these data bases with a far wider audience than was originally intended but we have not been asked, fortunately, to share these development costs.

COMPUTER ASSISTED INSTRUCTION VERSUS ON-LINE BIBLIOGRAPHIC RETRIEVAL

Most ASIS members are more familiar with on-line bibliographic retrieval systems, such as the National Library of Medicine's MEDLINE 4/, than they are with computer assisted instruction. The similarities are confusing, rather than enlightening. With both systems users sit at a terminal connected to a computer, hit keys, read printouts or displays, and hit the keys again. Identical terminals can be used for either. These terminals may well be located in a library, although the clusters of student users tend to be noisier than the run of the mill library patron. After that the differences start to build up.

Operating differences between the two types of on-line systems are given in Table I. The intellectual differences are perhaps even greater. They have been summarized by G. Octo Barnett:

"The CAI activity requires a high level of educational commitment on the part of the user, and is thus much more closely related to classical clinical teaching than it is to the use of a library resource.

"The user of the CAI network does not have to have any significant knowledge of the field in order to use the system profitably. Thus, the system attempts to teach in a very active fashion, rather than just providing pointers to an educational resource.

"The CAI network attempts to serve a much greater variety of users, varying from practicing physicians and nurses in community hospitals, to house staff and fellows in teaching hospitals, to medical students, and to a wide variety of paramedical personnel such as pharmacists, nurse practitioners, physician assistants, etc.

"Because of the high degree of educational content of the CAI network, it requires much closer contact and more intense interactions between the users and the subject matter developers. This program is really in a stage of rapid evolution and development, and it is obvious that evolution will occur. This would contrast to the on-line bibliographic services, which are fairly stable in regard to specifications and potential users." 2/

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TABLE I

COMPARISON OF COMPUTER ASSISTED INSTRUCTION AND ON-LINE BIBLIOGRAPHIC SERVICES

Computer assisted instruction	On-line bibliographic services
1. User needs no journal, book or report holdings.	1. User requires access to sources cited.
2. Use of terminal cannot be delegated, although it can be shared. Patron must use directly.	2. Although users are encouraged to make searches themselves, use can be delegated to trained searcher/analyst.
3. Self-instructional. User needs only to know how to log-in, plus general subject knowledge. Teaches actively.	3. Successful/efficient use may require training in searching vocabulary/commands.
4. "Free-standing." Terminals can be placed for maximum user exposure, e.g., residents' lounges and day rooms.	4. Requires literature back-up. Terminals should be installed in or near library.
5. User transactions are "closed." At the end of session user need do no further work.	5. User transactions are "open." At the end of transaction, user has further non-terminal work to do, such as look up furnished citations.
6. Portions of the data base can be stored and modified in local computers.	6. Size of data base and bibliographic standards dictate central storage with no user modifications.

Libraries, which may already have terminals for use with MEDLINE, and which know how to file, retrieve, and not lose the associated visual materials--some OSU programs require .35 mm slides or hard copy equivalents, MGH programs need easily pilferable booklets of ECG strips--make excellent physical locations for the CAI activity. The educational commitment to which Dr. Barnett alludes--a commitment which requires preparation of a use and evaluation plan, integration of the CAI materials into the curriculum and faculty commitments to prepare additional units of instruction--is more than the usual librarian can muster. When we pointed this out to one librarian he said, "Thank you," and returned the next week with his dean!

Librarians or not, the network's contracts with the using institutions are mediated through individuals, who require a peculiar mixture of the talents of spark plug, technological gate keeper and plain, old-fashioned bird dog. These "users," our office shorthand for the network contact points, are a well-degreed lot. A recent tabulation showed 24 M.D.'s, 12 Ph.D.'s, 2 D.O.'s and one each, Sc.D. and M.D., Ph.D.

They live in a variety of academic departments. We checked the user list after the recent charging flurry for survivors. We found the addresses given in Table II:

TABLE II
ACADEMIC BASES OF NETWORK "USERS"

Clinical Departments	15
Medical Education Offices	13
Libraries	11
Computer Centers	6
Preclinical Departments	5
Audiovisual Service Departments	2

The existence of an "Office of Medical Education"--a formal organizational component devoted to understanding and improving the teaching process, as contrasted with the emphasis on teaching content characteristic of the more traditional departments--seems to influence an institution's becoming a user of the network, even if the Office is not the official contact point. We recently compiled a list of "Offices of Medical Education" from a standard directory, 1/, and compared the institutions with our peak network users list, as of January 1974. The results are set forth in the 2 x 2 contingency table below:

TABLE III

INFLUENCE OF "OFFICES OF MEDICAL EDUCATION"

		Offices of Medical Education Listed		
		NO	YES	
(Users of the) (LHNCBC CAI) (Network)	YES	26	28	54
	NO	44	13	57
		70	41	111

This table gives a chi-square of 10.04, which is significant at the 0.005 level, apparently reflecting both the tendency of institutions with Offices of Medical Education to become users of the network, and for those institutions without such offices not to become users.

THE USES OF THE NETWORK

One of our "users," David A. Kronick, has written: "Anyone who sits at a terminal interacting with a computer based teaching program must feel the presence of another fine and active intelligence who is using the

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computer as an effective intermediary, and thus providing greater access to his teaching skills." 3/. Terminal interactions are as difficult to analyze and classify as are many other varieties of protracted, inter-personal encounters. Institutions using our CAI programs have reported the following uses:

a. Introduction of CAI on campus. A standard scenario is that created by the enthusiast trying to convince other faculty members of the merits of CAI. They may have heard of it or even witnessed a demonstration at a meeting, but have never before had the opportunity of examining CAI at leisure in their own offices, not over a forest of shoulders. The network gives both faculty and students an opportunity to test this novelty in a familiar environment.

b. Complement to local CAI activities. Another scenario. Professor X has spent two years working with his local computer center to develop the single perfect CAI program. It's great--almost as good as he says--but it's the only one he has, and you can't make a meal out of appetizers. The programs offered over the network can complement and contrast with his program.

c. Resource for experimentation in education. A standard pedagogical experiment is a comparison of teaching strategies and methods. The CAI network has made it possible to import new teaching methods without having to import or reprogram faculty members.

d. Evaluation. Evaluation has at least two major aspects. One is the evaluation of the materials themselves, which faculty members have taken to as gleefully as they turn to commenting on other faculty members' textbooks. The other is the use of some but not all of the programs to evaluate the computer assisted instructee. At least one of the National Boards is vigorously exploring the use of terminal interactions to replace the traditional, expensive, and not especially reliable oral examinations.

e. Continuing education. Although we have few programs designed specifically to meet the needs of the practicing physician, and none which have qualified to provide the necessary continuing education credits, our users have found that programs designed for undergraduate and graduate medical education can interest and challenge the person whose medical school days are far behind. The Dean of a medical school has told us that his most successful lectures to doctors in practice are the same that he gives to his senior classes. The same relationship seems to hold true for CAI courses.

f. Generation of new materials. In times past, faculty members wishing to create CAI materials have had to find a computer to use and perhaps learn or, worse, invent a programming language. The network has made it possible to write programs in English, with the remote computer acting as guide, tutor and editor. The format is, necessarily, limited to that of the existing programs although the content differs. We have had a limited success in encouraging such authoring. The bottleneck has, all too often, been the reluctance of the host computer centers to accept such programs and integrate them with their own.

g. Non-directed use. We call this the "show and tell" mode. A terminal, with clear and unambiguous instructions for its use and a trouble-shooter within call, is placed in a library or a residents' lounge and its use ad libitum encouraged, just as one places books on reading tables. This method produces tremendous student enthusiasm, logs lots of hours of use but little in the way of usable reports. We know of at least two instances where the student enthusiasm has pressured the faculty into taking computer assisted instruction seriously. The students like CAI because it lets them do their own thing, at their own pace.

h. Remedial use. One institution had hoped to use the Ohio State University gross anatomy sequence in a paired comparison of CAI vs. conventional teaching. Their terminals came too late for the planned experiment, but just in time to salvage 14 students who had been failing gross anatomy. Use of CAI raised their grades to the middle of the class average. Our present network costs make it difficult to compete with classroom teaching on a cost basis but compare very favorably, both in cost and effectiveness, with individual tutoring.

i. Integration into the curriculum. This has been a desideratum since the beginning of the network. With a few brilliant exceptions, it has not come to pass. Curriculum revision takes time. Using institutions are reluctant to commit themselves to dependence upon what they regard, rightly or wrongly, as a transient phenomenon. We have, however, seen the transition from treating our CAI programs as "recommended reading" to making them "required reading," and the inclusion of specific units in planned laboratory sessions.

THE FUTURE OF THE NETWORK

The medium. The past two years have taught the authors more than they really wanted to know about the problems involved in interconnecting three computer centers, a nation-wide time-sharing network and as many as 80 using institutions. The present configuration is experimental and, like other bread-boards, tremendously cost-effective if you ignore the original purchase price of the components and don't try to make it run forever, or make another one just like it. Unlike bibliographic stores, all of our data bases do not have to be kept on line at all times to all prospective users. There must be methods of chopping off useful subsets and shipping them off to local users, to use or modify as they see fit, without tying up a transcontinental communication channel every time that a student wishes to use a program.

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We intend to spend the next year looking for such methods.

The message. The same past two years have taught us a great deal about the computer assisted instruction programs on the network. We occasionally find time to glance, covetously, at CAI programs in health sciences already written but not on our network. These need to be accessioned, evaluated, translated into some standard form and made available for distribution. There is an even larger domain of materials which need to be, but have not, been written. Other agencies have specific missions in funding content development but we feel that many useful things remain to be done in standardization of formats and languages, in evaluation, specifically of teaching strategies, in helping subject experts translate their skills into effective teaching programs and, on days for dreaming impossible dreams, tackling such sordid but unavoidable problems as author incentives and/or academic and financial recognition and remuneration.

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